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— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii)) for the following designations AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VC, VN, YU, ZA, ZM, ZW, ARIPO patent (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG)*

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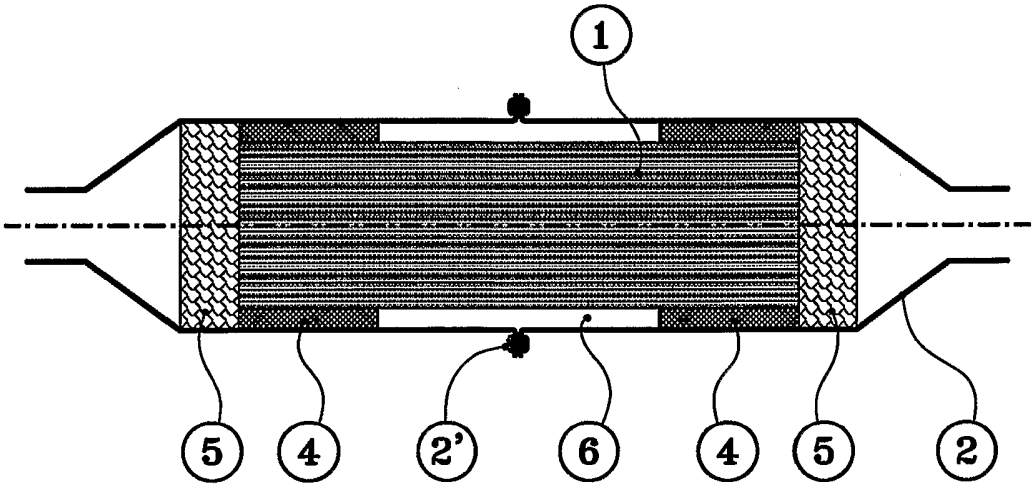
(54) Title: CANISTER FOR FUEL TANK



(57) Abstract: Canister for fuel tank comprising a housing (2) and an alveolar monolithic structure (1) based on activated charcoal, the monolithic structure (1) being fixed in the housing (2) by means of a fastening system comprising at least one foam (4, 5).

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— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii)) for the following designation US*
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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

Canister for fuel tank

The present invention relates to a canister for a fuel tank and a method for producing said canister.

Present-day liquid or gaseous fuel tanks must meet a set of standards due to the highly inflammable and often toxic nature of the fuel that they contain. Fuel leaks through defective tightness and evaporation losses have been in particular the subject of increasingly strict regulations, particularly for motor vehicle applications.

In fact, fuel tanks, particularly for motor vehicles, usually comprise a venting orifice for balancing the internal pressure with the atmospheric pressure, for example, during variations in fuel level resulting from the filling of the tank or from the fuel consumption by the engine, or during variations in temperature. Hence to meet the above standards, this venting orifice is conventionally connected to the atmosphere via a pipe and a chamber, commonly called a canister, containing an adsorbent substance for fuel vapours, usually activated charcoal. The role of the canister is to prevent the release of the fuel vapours to the atmosphere. The canister is regularly purged, i.e. the vapours are generally desorbed by means of an air stream and sent to the engine air intake system to be burned therein.

The activated charcoal usually employed as adsorbent may be in the form of a particle bed, a coating on a support, or an alveolar monolith of which the shape and porosity are controlled to obtain good adsorption while minimising pressure losses. Such a monolith is generally manufactured by forming (extrusion) and pyrolysis of a binder (for example ceramic)/carbon black mixture, as described in patent US 5 914 294.

The use of a combination of the particle bed and the monolith is also known, as described in patent US 6 540 815. Such hybrid canisters are in fact available on the market. They generally include, on the tank side, a main canister comprising a particle bed secured by a perforated grid, and on the atmosphere side, an auxiliary canister comprising an alveolar monolith. The latter is generally fixed in a housing by means of seals. This fastening mode presents a major drawback: it does not permit the efficient use of the whole volume of activated charcoal of the honeycomb, because of the partial plugging

of some of these channels and the inefficient use of the outer surface thereof. Moreover, due to its nature (generally solid elastomer), the seal does not participate in any way in the canister's adsorption function.

It is accordingly an object of the present invention to provide an improved fastening mode for a monolithic canister, which serves to remedy the above drawbacks in a simple manner.

For this purpose, the present invention relates to a canister for a fuel tank comprising a housing and an alveolar monolithic structure based on activated charcoal, the monolithic structure being fixed in the housing by means of a fastening system comprising at least one foam. The use of a foam serves to make maximum use of the surface area and the pores of the alveolar structure in contact with it, and in doing so, avoids hindering the adsorption of the vapours by the monolithic structure.

The canister according to the invention is intended in particular for internal combustion engines supplied with volatile liquid fuels and, in particular, for engines for motor vehicles (cars, lorries, motorcycles).

Fuel here means a liquid or gaseous volatile hydrocarbon suitable for supplying internal combustion engines. The canister according to the invention is particularly suitable for volatile liquid hydrocarbons. The expression "volatile liquid hydrocarbon" means a liquid hydrocarbon (which, in normal engine running conditions, is in the liquid state in the fuel tank of the fuel system) which has a saturation vapour pressure above 1 bar at 293 K (20 °C). Volatile liquid hydrocarbons commonly used for supplying internal combustion engines of motor vehicles are those sold on the market under the name "petrol" and intended for initiated-ignition, so-called "explosion"' internal combustion engines.

The canister according to the invention comprises at least one housing in which an alveolar monolithic structure, which constitutes the active (adsorbent) element of the canister, is fixed. It is understood that the canister according to the invention may comprise a plurality of housings and that each of them may comprise a plurality of monolithic structures and/or a combination of alveolar monolithic structures (i.e. porous structures in a single piece) and particulates (i.e. particle beds). It should be noted that the housing of the canister according to the invention can be cast in a single piece with the tank for which it is intended and/or with its filling tube. It may also integrate some of its accessories such as a liquid/vapour separator, for example.

According to a preferred variant of the present invention, the canister actually constitutes an auxiliary canister, added to a main canister comprising a bed of activated charcoal particles. Main and auxiliary canisters mean respectively a canister with a high adsorption capacity and a canister with a lower adsorption capacity. As described in the above cited patent US 6 540 815, the main canister is preferably positioned on the tank side (i.e. close to and communicating directly with it) and in a particularly preferred manner, also in contact with the engine air intake system (to permit the purging of the canister), whereas the auxiliary canister is positioned on the venting-to-atmosphere (ventilation) side. For this purpose, the monolithic structure and particle bed (which constitute the active elements of the canisters) can be fixed in separate housings. Advantageously, they are fixed in one and the same housing. This may have been manufactured in one piece, or may consist of a plurality of parts manufactured separately and then assembled together.

In the hybrid canister according to this variant of the invention, the particle bed may be fixed in its housing in any known manner; it may, for example, rest on a perforated grid (with the understanding that the perforations must be sufficiently large to allow the passage of the evaporation to be adsorbed without too much pressure loss, but not too large, in order to prevent the particles from passing through), and may be contained in a bag of a given permeability. A perforated plate placed on springs yields good results.

The monolithic structure of the canister according to the invention is an alveolar (porous) structure based on activated charcoal, which may be a foam, a honeycomb or any support impregnated with activated charcoal (for example cardboard). "Foam" means an expanded structure with open or closed cells of substantially spherical shape. This foam may consist of a polymer containing carbon black and expanded. "Honeycomb" means a structure comprising open or closed cells having any cross section, generally circular or hexagonal, with essentially parallel walls from one cell to the next. Honeycomb structures are ideal within the framework of the present invention and, in particular, those described in the US patents mentioned above.

The monolithic structure may have any shape. Preferably, it is substantially cylindrical (i.e. elongate shape with a substantially circular cross section) or paralletepipedal (the same, but with a square cross section). For a honeycomb, its cells are generally placed with their wall parallel to the flow direction of the gases to be adsorbed. These cells may have any cross section

(circular, square, triangular). Honeycombs with square or triangular cross sections are available on the market and yield good results.

The housing of the canister according to the invention can be made in a single piece or in a plurality of assembled parts. It is preferably made of a material compatible with the hydrocarbons that the canister is likely to treat. This material may be plastic or metal. Thermoplastics yield good results in connection with the invention, particularly because of the advantages of weight, mechanical strength, chemical resistance and easy processing. Thermoplastic here means a thermoplastic polymer, including thermoplastic elastomers, as well as blends thereof. "Polymer" means both homopolymers and copolymers (binary or ternary in particular). Examples of such copolymers are, in a non-limiting manner: random copolymers, block copolymers and graft copolymers.

Any type of thermoplastic polymer or copolymer of which the melting point is lower than the decomposition temperature is suitable. Synthetic thermoplastics which have a melting range spread over at least 10 degrees Celsius are particularly suitable. Examples of such materials include those exhibiting polydispersity in their molecular weight.

In particular, use can be made of polyolefins, polyvinyl halides, thermoplastic polyesters, polyketones, polyamides and copolymers thereof. A blend of polymers or copolymers can also be used, as well as a blend of polymeric materials with inorganic, organic and/or natural fillers such as, for example, but not limitingly, carbon, salts and other organic derivatives, natural fibres, glass fibres and polymeric fibres. It is also possible to use multilayer structures consisting of stacked and joined layers comprising at least one of the polymers or copolymers described above.

Polyvinyl halides and polyolefins are suitable. A polymer often employed is polyethylene and, in particular, high-density polyethylene (HDPE). Polypropylene (PP), polyamides (PA: PA-6 containing glass fibres in particular) or polyacetal (POM or polyoxymethylene) are also suitable. POM yields good results particularly due to its resistance to HCs (hydrocarbons).

In a known manner, the impermeability of this plastic to volatile hydrocarbons can be improved by surface treatment (fluorination, sulphonation) and/or by the use of a barrier layer (for example, based on polyamide (PA) or a polymer of vinyl alcohol [homopolymer (PVOH) or ethylene/vinyl alcohol copolymer (EVOH)]). Alternatively, a bag of barrier material (for example EVOH) can be inserted into a housing of non-barrier plastic (for example

HDPE). This bag can also serve as a "container" for a particle bed in the case of hybrid canisters as mentioned above.

It should be noted that this variant (use of a bag of barrier material to contain a bed of adsorbent particles) also yields good results beyond the scope of the invention. It serves to overcome problems of choice of the material for manufacturing the canister (which must be both tough and impermeable) by decoupling the two functions: the rigidity, solidity function performed by a suitable and inexpensive plastic (HDPE for example) and the impermeability function performed by EVOH or another low-permeability plastic.

According to the invention, the monolithic structure (active element of the canister) is fixed in its housing by means of a fastening system comprising at least one foam (as defined above). Preferably, it mainly indeed essentially consists of one or more foams. This means that it consists of more than 50% (by volume) and preferably, of at least 90%, indeed 100% of foam(s) to avoid blocking the cells of the monolith.

This foam is advantageously filled with activated charcoal in order to participate in the canister's adsorption function. Such filled foams are available on the market and well known to a person skilled in the art. The foam is selected in accordance with its adsorption properties, the pressure losses that it causes and its mechanical properties. Preferably, it is a supple, compressible foam. Similarly, the shape of the foam is adapted to the fastening mode selected to prevent movements of the monolith in its housing.

Preferably, the fastening system comprises at least two foams, each positioned at one end of the monolithic structure, and of appropriate shape to match said ends. In particular, for a cylindrical or parallelepipedal canister, two circular or square foams can be used to wedge the ends of the monolith and block its axial movements. One can also or alternatively use a foam positioned at least partly on the lateral surface of the monolithic structure, to block its radial movements. According to one variant, the foam on the lateral surface has the shape of a hollow cylinder into which the monolith is inserted. According to another variant, the foam on the lateral surface is in the form of a tape wrapped around the monolith.

The present invention further relates to a method for producing a canister as described above. This method consists in fixing an alveolar monolithic structure based on activated charcoal in a housing by means of a fastening system comprising at least one foam containing activated charcoal. The foam

can be joined to the monolithic structure before insertion into the housing (preferred solution for foams on the lateral surface (called "lateral" foams) for example), or the structure can first be introduced into the housing and then wedged with the foam (preferred solution for end foams (called "end" foams) for example).

Preferably, the monolith is first joined to a "lateral" foam, the combination is inserted into at least a portion of the housing and then wedged with at least one "end" foam.

The present invention is illustrated in a non-limiting manner by Figures 1 to 5. Figure 1 shows a canister according to the prior art, while Figures 2 to 5 show certain preferred variants of the canister according to the present invention. In these Figures, identical numerals designate identical elements.

Figure 1 shows a canister according to the prior art, of substantially cylindrical shape, in which a honeycomb monolith based on activated charcoal (1) is fixed in a housing (2) by means of a single girth seal (3). This fastening mode does not permit optimal use of the whole volume of the honeycomb. In fact, not only the cross-hatched zone but also the entire outer surface of the honeycomb are not directly accessible to the hydrocarbon vapours because the channel entrances are plugged by the seal. These zones are only reached by diffusion across the pores of the charcoal, implying a very poor hydrocarbon load as well as a very poor purge.

In the canister according to the invention shown in Figure 2, the monolith fastening system comprises a first pair of foams containing activated charcoal (4) to prevent radial movements, and a second pair of low pressure loss foams (5) to prevent longitudinal movements and to ensure a good flow distribution over the entire cross section of the housing (2). The housing consists of two separate plastic parts joined together by a seal (2'). The zone (6) lying between the first two zones of foam containing activated charcoal (4) is filled with air.

The use of the foams (4)(5) as a permeable fastening system enables the vapours to contact the outer surface of the monolith. Moreover, this foam contains activated charcoal and also contributes to the adsorption of the hydrocarbon vapours. The use of low pressure loss foam to prevent axial movements helps to make the flow distribution uniform over the whole cross section and eliminates the least accessible zone of the honeycomb.

In the variant in Figure 2, the foams (5) are disc-shaped, while the foams (4) can be in several different shapes, of which two preferred variants are shown in Figures 3 and 4.

Figures 3 and 4 show two cross sections (one in a plane passing through the axis of the canister and one in a plane perpendicular to this axis) in a canister according to each of these variants. In the variant in Figure 3, the foam containing activated charcoal (4) has the shape of a hollow cylinder into which the monolith (1) is inserted. In the variant in Figure 4, the foam (4) is in the shape of a tape wrapped around the monolith (1).

Finally, the canister in Figure 2 is shown in Figure 5 as being an auxiliary canister (7) fixed in the same housing (2) as a main canister (8) containing activated charcoal particles. According to this variant, the auxiliary canister (7) is connected to the atmosphere (9), while the main canister (8) is connected to the tank (10) and to the air intake system (for purging)(11). The housing (2) comprises an outer chamber and an inner wall (2') bounding, with the outer wall, a space for the monolithic structure of the auxiliary canister (7). This is fixed in said space according to the variant shown in Figure 2.

CLAIMS

1. Canister for fuel tank comprising a housing (2) and an alveolar monolithic structure (1) based on activated charcoal, the monolithic structure (1) being fixed in the housing (2) by means of a fastening system comprising at least one foam (4, 5) containing activated charcoal.

2. Canister according to the preceding claim, characterised in that it constitutes an auxiliary canister (7) added to a main canister (8) comprising a bed of activated charcoal particles.

3. Canister according to the preceding claim, characterised in that the main canister (8) is positioned on the tank side, while the auxiliary canister (7) is positioned on the venting-to-atmosphere side.

4. Canister according to either of Claims 2 and 3 characterised in that the monolithic structure (1) and the particle bed are fixed in one and the same housing which is common to both.

5. Canister according to any one of Claims 2 to 4, characterised in that the particle bed is contained in a bag of barrier material.

6. Canister according to any one of the preceding claims, characterised in that the monolithic structure (1) is a honeycomb structure.

7. Canister according to any one of the preceding claims, characterised in that the housing (2) is based on high-density polyethylene (HDPE), polypropylene (PP), polyamide (PA) or polyacetal (POM or polyoxymethylene).

8. Canister according to any one of the preceding claims, characterised in that the fastening system comprises at least two foams (5), each positioned at one end of the monolithic structure (1).

9. Canister according to any one of the preceding claims, characterised in that the fastening system comprises at least one foam (4) positioned at least partly on the lateral surface of the monolithic structure (1).

10. Method for producing a canister according to any one of the preceding claims, according to which an alveolar monolithic structure (1) based on

activated charcoal is fixed in a housing (2) by means of a fastening system comprising at least one foam (4, 5).

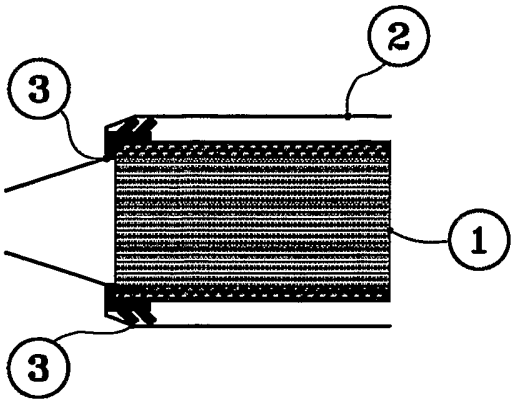

Fig. 1

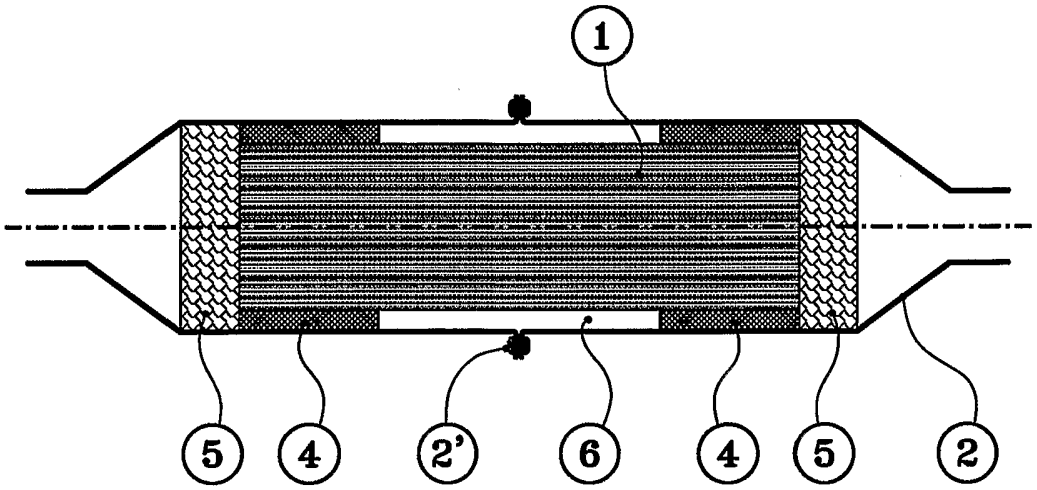

Fig. 2

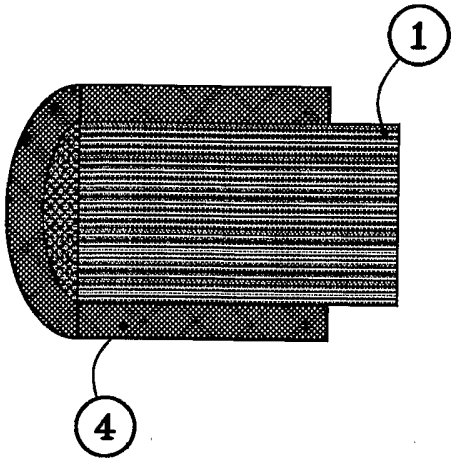

Fig. 3

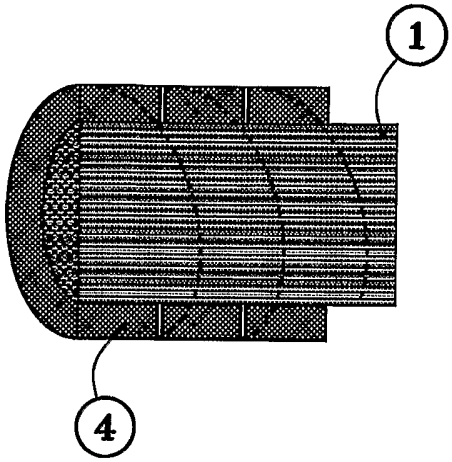

Fig. 4

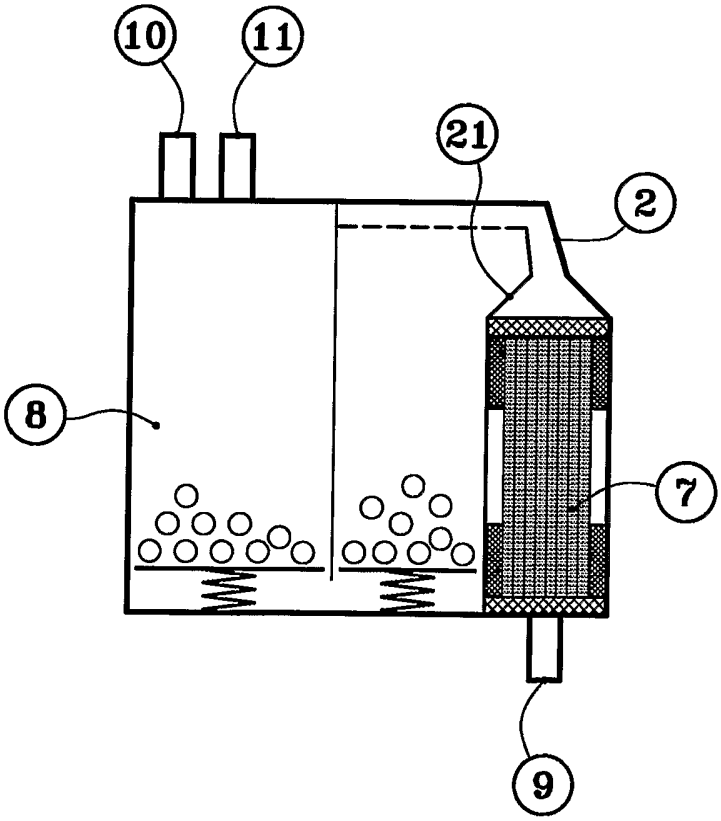

Fig. 5

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP2005/051387

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 F02M25/08

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B60K F02M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	DE 101 50 062 A (SANDLER HELMUT HELSA WERKE) 20 February 2003 (2003-02-20) column 5, line 11 - line 13 column 5, line 33 - line 42 figure 1	1,5,6, 8-10 2-4,7
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A	US 4 386 947 A (OKAMOTO KUNIO ET AL) 7 June 1983 (1983-06-07) the whole document	1-10

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
9 June 2005	21/06/2005

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Wisnicki, M

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP2005/051387

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6 540 815 B1 (TOLLES EDWARD D ET AL) 1 April 2003 (2003-04-01) cited in the application the whole document	1-10

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